ACCESSION #: 9307090093
LICENSEE EVENT REPORT (LER)

FACILITY NAME: PILGRIM NUCLEAR POWER STATION PAGE: 1 OF 9

DOCKET NUMBER: 05000293

TITLE: Automatic Scram Resulting From Operation of Auxiliary Transformer Differential Relay During Power Ascension
EVENT DATE: 05/31/93 LER #: 93-014-00 REPORT DATE: 06/60/93

OTHER FACILITIES INVOLVED: N/A DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 24

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On May 31, 1993, at 1921 hours, an automatic scram occurred while at 24 percent reactor power. The event included a trip of the Turbine-Generator and transfer of the Auxiliary Power Distribution System. The scram was the result of the closing of the Turbine Stop Valves while the Turbine first stage pressure was greater than the scram bypass pressure. The Turbine Stop Valves were closing as a result of the Turbine trip. The Turbine-Generator trip was initiated by the operation of a Unit Auxiliary Transformer differential relay.

The operation of the relay was investigated for cause. The investigation included relay calibration, differential circuit wiring checks, Unit Auxiliary Transformer insulation resistance testing and oil sample analysis, cable insulation resistance testing, breaker testing, and performance of a test approximating the conditions existing at the time of the event. The investigation could not determine the cause for the

operation of the relay. The unit returned to commercial service on June 3, 1993.

This event occurred during power ascension from a refueling outage with the reactor mode selector switch in the RUN position. The Reactor Vessel (RV) pressure was 940 psig with RV water temperature at 540 degrees Fahrenheit. This report is submitted in accordance with 10 CFR 50.73(a)(2)(iv). This event posed no threat to the public health and safety.

END OF ABSTRACT

BACKGROUND

The Auxiliary Power Distribution System (APDS) consists of six 4160 VAC buses. The APDS is divided into emergency service (Buses A5 and A6) and normal service (Buses A1, A2, A3, A4). Buses A5 and A6 supply power to essential loads required during normal operations and abnormal operational transients and accidents. Buses A1, A2, A3, A4 supply power to other station auxiliaries during planned operations. Power is distributed to the six 416 VAC buses during normal operation from either the unit source (Unit Auxiliary Transformer or the preferred offsite source (Startup Transformer). The preferred power source is use to supply the 4160 VAC buses during normal startup and shutdown. After the main generation has been synchronized to the 345 KV transmission system, the 4160 VAC buses are transferred from the preferred power source to the unit power source. The 4160 VAC emergency service Buses A5 and A6 can also be supplied from the standby power source (Emergency Diesel Generators 'A' and 'B'), the secondary power source (Shutdown Transformer), or the Station Blackout Diesel Generator (Bus A5 or Bus A6). Located at the end of this report is a figure depicting a simplified single line diagram of the emergency service portion of the APDS and related power sources.

At the time of the event, power ascension from the recent refueling outage (RFO 9) was in progress. Operating conditions and systems' status were as follows:

o The reactor power level was approximately 24 percent with the reactor mode selector switch in the RUN position. The Reactor Vessel (RV) pressure was approximately 940 psig with the RV water temperature at approximately 540 degrees Fahrenheit. The RV water level was approximately +29 inches. The Turbine first stage pressure was approximately 110 psig.

o The Emergency Diesel Generators (EDGs) 'A' and 'B' were in standby service. The Core Standby Cooling Systems including the Residual Heat Removal (RHR) System were in standby service. The Reactor Core Isolation Cooling System was inoperable.

o The Recirculation System motor-generator (MG) sets/pumps 'A' and 'B' were in service in the manual control mode. Core flow was approximately 23 million pounds per hour.

o The Reactor Water Cleanup (RWCU) System was in service.

o The Main Condenser 'B' waterboxes were being backwashed.

o The 345 KV transmission system lines 342 and 355 were energized. The 345 KV switchyard air type circuit breakers 102, 103, 104 and 105 were closed. The Main Transformer, Start-up Transformer (SUT) and Unit Auxiliary Transformer (UAT) were energized. The Shutdown Transformer (SDT) and Station Blackout Diesel Generator were in standby service.

o Safety-related swing type 480 VAC load center Bus B1 was energized by Bus A5.

o The source of power to the APDS buses was being transferred as part of power ascension.

The APDS buses were being transferred in accordance with Procedure 2.2.4 (Rev. 9), "Unit Auxiliary Transformer". For a transfer, the synchronizing switch of the bus to be transferred is placed in the ON position, the breaker connecting the UAT to the bus is closed, the breaker connecting the SUT to the bus is opened, the synchronizing switch is placed in the OFF position, and the automatic transfer switch is placed in the ON position. The nonsafety-related buses are transferred first followed by the safety-related buses. After individually transferring Buses A1, A2, A3 and A4 to the UAT, the source of power for Bus A5 was being transferred from the SUT to the UAT. Switchgear breaker 152-505 (A505) was closed and breaker 152-504 (A504) was being opened with the transfer switch in the OFF position.

EVENT DESCRIPTION

On May 31, 1993, at 1921 hours, an automatic Reactor Protection System (RPS) scram signal and scram occurred while at 24 percent reactor power.

The scram signal occurred as a result of a Turbine-Generator trip. The Turbine-Generator trip was initiated by the actuation of the UAT phase 'C' differential relay 187-3 that actuated the Generator Lockout Relay 286-1. The actuation of relay 286-1 included the following designed responses:

o Automatic opening of 345 KV switchyard ACBs 104 and 105.

o Automatic transfer of the source of power to Buses A1, A2, A3, and A4 from the UAT to the SUT. Bus A5 and related electrical loads became de-energized and was automatically re-energized by the SDT after a time delay of approximately 12 seconds.

The de-energization of Bus A5 and related 480 VAC Bus B1 and motor control centers (MCCs) resulted in responses that included:

o Automatic transfer of Bus B6 from Bus B1 to Bus B2.

o Automatic trip of the Recirculation System Loop 'A' MG set/pump.

o Automatic actuation of a portion of the Primary Containment Isolation Control System (PCIS) Groups 2,3, and 6 circuitry and Reactor Building Isolation Control System (RBIS). The related inboard Group 2 isolation valves that were open closed automatically. The related Group 3/RHR System Shutdown Cooling (SDC) isolation valves MO-1001-47 and -50 and Low Pressure Coolant Injection (LPCI) injection valves MO-1001-29A/B remained closed. The related inboard Group 6/RWCU System isolation valve MO-1201-2 closed automatically. The Reactor Building Train 'A' supply and exhaust ventilation dampers closed automatically and the Standby Gas Treatment System (SGTS) Train 'A' started automatically.

o Automatic opening of the Generator Field Breaker 41M.

o Automatic actuation of the Turbine Master Trip Solenoid (MTS-1) that initiated a Turbine Trip (VT-1).

The Turbine trip included the following designed responses:

o Closure of the Turbine Stop Valves and Combined Intermediate Valves. The Turbine Stop Valves closure (i.e., not fully open) resulted in the RPS scram signal.

o Closure of the four Turbine Control Valves and the sequential opening of the three Turbine Bypass Valves.

o Actuation of the Turbine Lockout Relay 286-2.

As expected, the RV water level decreased in response to the scram due to a decrease in the void fraction in the RV water. The RV water level eventually decreased to approximately +3 inches. The decrease in RV water level, to less than the low RV water level setpoint (calibrated at approximately +12 inches) resulted in automatic actuations of the PCIS and RBIS.

The PCIS actuation resulted in the following designed responses:

o Automatic closing of the outboard Group 2 isolation valves that were open. The inboard Group 2 isolation valves remained closed.

o The Group 3/RHR System SDC isolation valves MO-1001-47 and -50 remained closed. The Group 3/RHR LPCI valves MO-1001-29A/B remained closed.

o Automatic closing of the outboard Group 6/RWCU System isolation valves MO-1201-5 and -80. The inboard Group 6 isolation valve MO-1201-2 remained closed.

The RBIS actuation resulted in the automatic closing of the Reactor Building/Secondary Containment System (SCS) Train 'B' supply and exhaust ventilation dampers and automatic start of the SGTS Train 'B'. The Train 'A' ventilation dampers remained closed and the SGTS Train 'A' remained in service.

Initial Control Room operator response was orderly and included the following. The reactor mode selector switch was moved from the RUN position to the SHUTDOWN position and all control rods were verified to be inserted in accordance with procedure 2.1.6, "Reactor Scram". Emergency Operating Procedure EOP-01, "RPV Control", was initiated because the RV water level decreased to less than +9 inches. Procedure 2.1.7, "Vessel Heatup and Cooldown", was initiated.

The PCIS circuitry was reset and the RWCU System was returned to service at 1934 hours. The RPS was reset at 1950 hours. At 1953 hours, the source of power for Bus A5 was transferred from the SDT to the SUT. The RBIS circuitry was reset, the SGTS was returned to standby service, and the Reactor Building ventilation system was returned to service at 2010 hours. The Recirculation System MG set/pump 'A' was restarted at 2026

hours. After resetting the Generator Lockout Relay 286-1, the 345 KV switchyard ring bus was restored at 2057 hours when ACBs 104 and 105 were reclosed. EOP-01 was terminated at 2101 hours.

On June 1, 1993, at 0205 hours, the Recirculation System Loop 'B' MG set/pump was removed from service and the RHR System Loop 'B' was put into service in the SDC mode with one pump in service.

Problem Report 93.9283 was written to document the event. The NRC Operations Center was notified of the event in accordance with 10 CFR 50.72 at 2013 hours on May 31, 1993.

A post trip review of the event was initiated in accordance with procedure 1.3.37 (Rev. 8), "Post Trip Reviews".

CAUSE

The cause of the scram was the closing of the Turbine Stop Valves (i.e., not full open) with the Turbine first stage pressure at approximately 110 psig.

The cause of the operation of the UAT phase 'C' differential relay 187-3 was investigated. The investigation revealed no reason for the operation of the relay. The following possible causes were investigated and were eliminated as the probable cause of the operation of the relay (Westinghouse type HU-1, style 290B346A10):

o Actuation of the UAT overcurrent differential circuit:

o Visual inspection and checks of connections for tightness were satisfactory.

o The phase 'A', 'B', 'C' current transformers were saturation tested with satisfactory as-found results.

o The phase 'C' relay 187-3 was calibrated with satisfactory as-found results.

o A loose screw was found and removed from the phase 'C' relay 187-3. The loose screw, located inside and at the bottom of the relay housing, was not believed to be the cause of the trip of the relay.

o The phase 'B' and 'C' relays (187-3) were interchanged for

investigative purposes in anticipation of planned testing (TP 93-101).

o Fault in the UAT, Isophase Bus Ducts, or cables from the UAT to the APDS buses:

o The UAT was insulation resistance tested with satisfactory as-found results.

o An oil sample from the UAT was analyzed for dissolved gases. The analysis results were found to be in the normal range.

o The Isophase Bus Ducts connecting the Generator to the Main Transformer and UAT were insulation resistance tested with satisfactory as-found results.

o The 4160 VAC cables from the UAT to the APDS buses were insulation resistance tested with satisfactory as-found results.

o Fault or misoperation of the Bus A5 switchgear breakers 152-504

The breakers were tested. The testing consisted of timing, contact resistance, phase-to-phase and phase-to-ground insulation resistance tests. The tests were completed with satisfactory as-found results.

Interfacing components that could not be verified by the methods noted above were tested as part of Procedure TP 93-101 (Rev. 0), "A5 Transfer Between Startup and Unit Auxiliary Transformer". The procedure was written to approximate the conditions existing at the time of the event on May 31, 1993. The test included the start of selected electrical loads, and transfer of APDS buses from the SUT to the UAT. Buses Al, A2, A3, and A4, and A5 were transferred with satisfactory results. After the transfer of Bus A5 to the UAT, Bus A5 was transferred to the SUT and then back to the UAT. Bus A5 was transferred to and from the UAT and SUT four times. The transfers occurred with satisfactory results.

During the performance of TP 93-101, a circulating current of approximately 500 amperes was detected while both the UAT and SUT were powering Bus A5 in parallel. Circulating currents during bus transfers have been observed in the past. This information and the differential relay current input readings measured during the performance of TP 93-101 were provided to the Nuclear Engineering Department for further analysis. If the analysis reveals significant new information regarding the cause

of the operation of the differential relay, this report will be supplemented.

CORRECTIVE ACTION

The UAT phase 'B' and 'C' differential relays were left interchanged as an investigative aid in the event the UAT differential circuit operates in the future.

The unit returned to commercial service at 2322 hours on June 3, 1993.

The source of power for the APDS including Bus A5 was subsequently transferred from the SUT to the UAT with satisfactory results.

SAFETY CONSEQUENCES

The Standby AC Power (4160 VAC) System consists of EDGs 'A' and 'B' that are self contained and independent of the offsite power sources. Bus A5 and related AC powered load center busses, motor control centers, and distribution panels including Panels Y3 and C-941 became de-energized for approximately 12 seconds. Bus A5 and related electrical system became de-energized due to the automatic opening of switchgear breaker 152-505 while breaker 152-504 was open. Breaker 152-504 was open and did not close because the Bus A5 transfer switch was in the OFF position at the time for the transfer. The EDG 'A' did not start as a result of Bus A5 becoming de-energized (i.e., switchgear breakers 152-504 and 152-505 open) because the SUT-Bus A5 degraded voltage relays are connected to the 4160 VAC feeder cables on the SUT side of switchgear breaker 152-504. The SUT remained energized during the event. The SDT automatically re-energized Bus A5 after a designed time delay of approximately 12 seconds.

The post trip review included safety assessments regarding transient RV and reactor parameters, the initiating RPS trip signal, Drywell pressure and temperature, Suppression Pool water level and temperature, and safety limits. The assessments concluded automatic actions that occurred should have, the initiating RPS trip signal was appropriate for this event, Technical Specifications were met, and safety limits were not exceeded.

The decrease in the RV water level was the expected response to the scram and accompanying shrink in the RV water. The Technical Specifications 3.1 and 3.2.A trip setting for a low RV water level is >/= +9 inches. The resulting PCIS and RBIS actuations were the expected designed responses to a low RV water level condition (i.e., less than the

calibrated setting of approximately +12 inches).

This report is submitted in accordance with 10 CFR 50.73(a)(2)(iv) because the actuation of the RPS, although an expected designed response to the closing of the Turbine Stop Valves with the Turbine first stage pressure at greater than approximately 108 psig, was not planned. This report is also submitted in accordance with subpart (a)(2)(iv) because the actuation of portions of the PCIS and RBIS, although a designed response to the de-energization of relays powered from Bus A5 via Bus B1/MCC-B17/Panels Y3 and C-941, was not planned.

SIMILARITY TO PREVIOUS EVENTS

A review was conducted of Pilgrim Station Licensee Event Reports (LERs) submitted since January 1984. The review focused on LERs submitted in accordance with 10 CFR 50.73(a)(2)(iv) that involved a similar scram due to the operation of the UAT differential circuitry or other Main Generator protective circuits. The review identified no scrams due to the operation of the UAT differential circuit and identified somewhat similar events involving the operation of other Main Generator circuits reported in LERs 50-293/89-026-01 and 90-008-00.

For LER 89-026-01, an automatic scram occurred on August 30, 1989, at 1917 hours, while at 65 percent reactor power. The cause of the scram signal was high RV pressure (ultimately 1069 psig) that occurred as a result of an automatic Turbine runback. The runback included the automatic adjustment of the Turbine Control Valves and sequential opening of the Turbine Bypass Valves. The runback occurred as a result of the failure of the primary winding of the Main Generator 24 KV phase 'A' potential transformer and a Generator Voltage Balance Relay 260 (General Electric type CFVB) wiring error that affected the transfer function of the Generator's Voltage Regulator. The wiring error was due to a drawing error. The error was not previously detected because the surveillance test procedure (3.M.3-39) used to functionally test the relay, although demonstrating the voltage balance relay functions and alarm functions, did not include a step to identify the auxiliary relay that actuates the same alarm (Panel C-3R, "Generator Potential Fuse Blown"). Corrective action taken included correction of the wiring error after correcting the drawing and revision of the surveillance procedure to identify the specific auxiliary relay that actuates when the relays are actuated during functional testing of the voltage balance relay.

For LER 90-008-00, an automatic scram due to a load rejection occurred on May 13, 1990, at 1603 hours, while at 100 percent reactor power. The

load rejection was caused by a momentary fault on the offsite 345 KV transmission system. The Main Generator's Loss of Field Relay 240 detected the fault and immediately tripped the generator without an expected 15 cycle time delay because one of its components, the telephone relay coil, was defective. The relay had been calibrated and functionally tested on October 26, 1989. At that time, the operation of the coil was tested in accordance with the vendor manual. The relay's time delay was built-in and not adjustable, and was not required to be timed. The relay was installed during plant construction (c. 1972).
The cause for the open coil was investigated and believed to be a random or age-related failure. The relay was the only one of its type (Westinghouse type KLF-1) installed at Pilgrim Station and was replaced with another type KLF-1 relay having an adjustable time delay. The relay's calibration sheet was revised to include a calibration of the adjustable time delay.

ENERGY INDUSTRY IDENTIFICATION SYSTEM (EIIS) CODES

The EIIS codes for this report are as follows:

COMPONENTS CODES

Relay, Differential Protective (187-3) 87
Transformer (UAT) XFMR

SYSTEMS

Containment Isolation Control System (PCIS, RBIS) JM
Engineered Safety Features Actuation System JE
(PCIS, RBIS, RPS)
Medium-Voltage Power System EA
Plant Protection System (RPS) JC
Reactor Water Cleanup (RWCU) System CE
Standby Gas Treatment System (SGTS) BH

Figure "Emergency AC Distribution" omitted.

10 CFR 50.73

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Senior Vice President-Nuclear June 30 , 1993
BECo Ltr. 93-86

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Docket No. 50-293
License No. DPR-35

The enclosed Licensee Event Report (LER) 93-014-00, "Automatic Scram Resulting From Operation of Auxiliary Transformer Differential Relay During Power Ascension", is submitted in accordance with 10 CFR Part 50.73.

Please do not hesitate to contact me if there are any questions regarding this report.

E.T. Boulette, Phd

DWE/bal

Enclosure: LER 93-014-00

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Standard BECo LER Distribution

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